DATELINE: LOS ALAMOS

JAPAN ENLISTS LAB SCIENTISTS TO STUDY ANCIENT COLORADO VOLCANO

RESEARCH WILL HELP IN CHOICE OF UNDERGROUND NUCLEAR WASTE REPOSITORY

A study of a 34-million–year-old eroded, extinct volcano in southwestern Colorado will help the Japanese government choose a safe site for a future underground nuclear waste repository.

The recent eruption of Mount Usu near Date in northern Japan highlights the dangers posed by the complex plate tectonic setting in which the Japanese islands lie. One of the most tectonically and volcanically active areas on the Earth, Japan has more than 200 active or recently active volcanoes. And new volcanoes are known to form near the sites of existing ones.

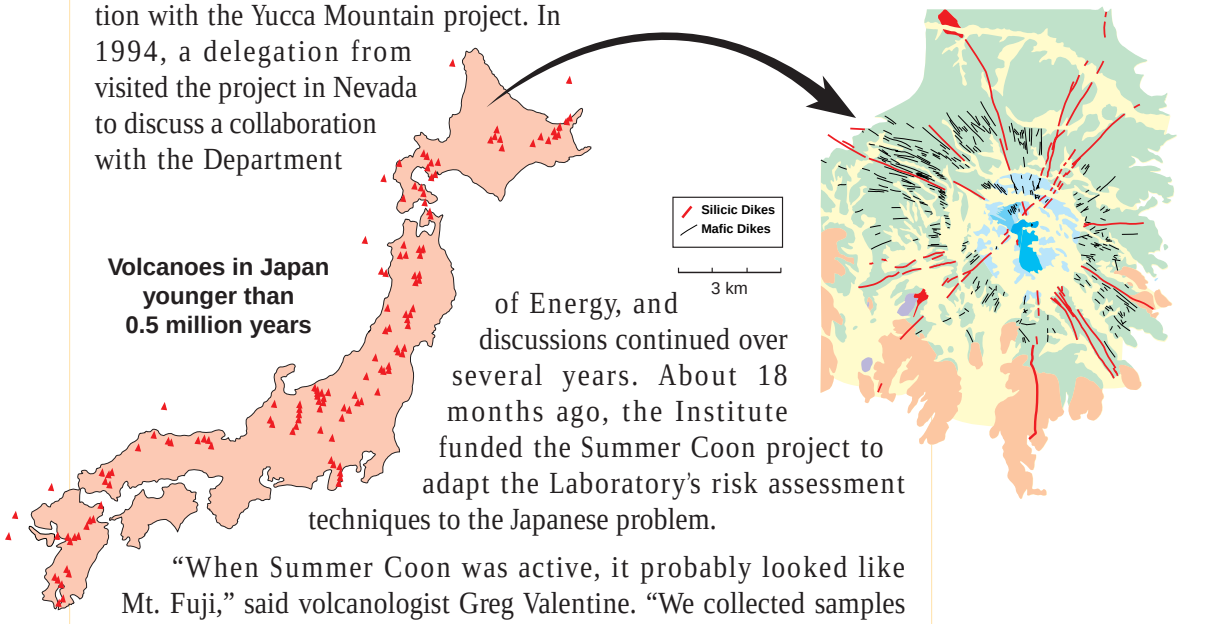
Japan's three main islands provide limited land mass for a large population, making it difficult to find a site for safe geologic disposal of high-level radioactive waste, necessary to a country that intends to increase its reliance on nuclear power. To certify the safety of a repository for 100,000 years, the Japanese Nuclear Cycle Development

This is one of the main dikes of the Summer Coon volcano, with a natural arch known as La Ventana. The arch was formed by natural fractures within the dike. La Ventana is a popular recreation site.

Institute must understand the internal workings of nearby volcanoes and the range of their effects.

The completely exposed plumbing system of the Summer Coon volcano near Del Norte, Colo., in the eastern foothills of the San Juan Mountains allowed scientists from Los Alamos' Earth and Environmental Sciences Division to study effects for a volcano of similar size in Japan.

Laboratory scientists have been assessing volcanic risks for radioactive waste repositories since the late 1970s, in connection with the Yucca Mountain project. In 1994, a delegation from visited the project in Nevada to discuss a collaboration with the Department of Energy, and discussions continued over several years. About 18 months ago, the Institute funded the Summer Coon project to adapt the Laboratory's risk assessment techniques to the Japanese problem.



"When Summer Coon was active, it probably looked like Mt. Fuji," said volcanologist Greg Valentine. "We collected samples that indicated that most of its activity occurred within a 200,000-year span, which is a good analog for the kinds of volcanoes in Japan."

All of Japan's dead and eroded volcanoes are covered by forest or broken by faulting, which prevents study of their inner workings. The Summer Coon site is appealing for analog studies, because it is unfaulted and intact, and in a semi-arid climate, so rocks are well exposed.

"We are not so much interested in eruptions," Valentine said. "It's more about what's going on underneath, because the repository will be underground. By studying an eroded volcano, we get an integrated picture of what its plumbing was like through its life."

Valentine, fellow Los Alamos geologists Frank Perry and Giday WoldeGabriel and New Mexico Tech student Emily Desmarais concentrated their sampling last summer and fall on the central area that forms

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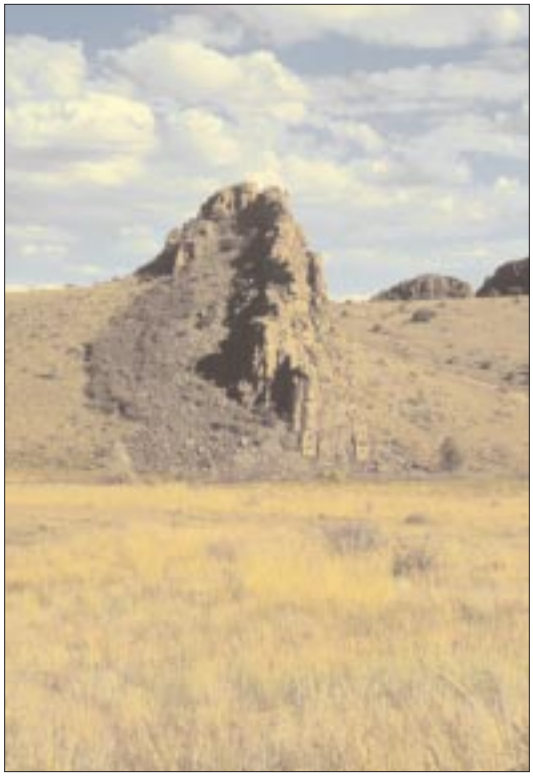
the main conduit for magma and the hundreds of dikes radiating from the center of the volcano. These long, narrow geological features are where the hot magma flowed into cracks and cooled, forming resistant ridges harder than the surrounding or host rock.

As the host rock eroded, the dikes became prominently visible. The researchers split into two teams and measured the location of dikes around half of the volcano using a global positioning system. They also measured the width of the dikes and any indication of effects on the surrounding rocks.

WoldeGabriel's task was to study the nature of hydrothermal processes, the hot fluids associated with multiple volcanic activities, such as the radial dikes at Summer Coon. The study determined the extent of hydrothermal alterations on the host rocks around the conduit in the center of the volcano, and around the various radial dikes.

"The hydrothermal processes transform the identity of the affected rocks, and most minerals are not comfortable with hot water," WoldeGabriel said. "Most rocks in the center of the volcano were transformed beyond recognition and bleached white, but we found that most hydrothermal alterations next to the radial dikes are localized and quite limited. In fact, there were no effects just 10 meters away from the dikes."



A large dike at the eroded Summer Coon volcano in the eastern foothills of the San Juan Mountains in southwestern Colorado.

The hydrothermally altered rocks at the center of the volcano and adjacent to the dikes record at least three types of hydrothermal processes, and the team is trying to determine when these alterations took place.

Based on the data collected by counting and measuring the lengths of the dikes,

Perry developed a probability model for risk assessment using Monte Carlo simulations. The Monte Carlo method is based on taking random samples from probability distributions that, in this case, were distributions for the length and orientation of the dikes.

"We needed to calculate the probability of a radial dike entering a repository site, as a function of distance of a new volcano from the site," Perry said. "If a new volcano forms within 5 or 6 kilometers of the repository, disruption of the repository is virtually guaranteed. As the distance increases from 5 to about 15 kilometers, the probability of disruption rapidly decreases.

"There is essentially zero risk if the volcano forms at distances greater than 15 kilometers from the repository," Perry said.

These results will help Japanese scientists determine how far away a repository needs to be from volcanic clusters, which will be part of the total equation in siting a repository. That process also must take into account many socio-economic factors such as proximity to population centers in addition to others associated with the natural environment.

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